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Aspiring Engineering Students And Their Abilities In Basic Science Subjects

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ABSTRACT

Engineering education is the most sought one by the students as well as by their parents. The geometrical growth in IT Industry has helped many engineers with lucrative jobs. This in turn has raised the economical status of middle income groups to the new orbit of lifestyle. This is a research study on "Aspiring engineering students and their abilities in basic science subjects"**.** This study analyzes confidence level of students in the subjects like Mathematics, Physics and Chemistry. Higher Secondary education in India is travelling through a new phase. Different educational boards have different learning methods and evaluation techniques. The Higher secondary education is getting the pressure from both 'Bottom-up' and 'Top-down' directions. The Bottom-up pressure is because of the high growth in the primary

schooling and Top-down pressure is because of the commitment to produce quality students for higher education. The result of this research study conveys that different self-efficacy levels of students of State Board (3.11±0.04), and Central Board (CBSE) (3.23±0.03).With respect to gender Male students had a significant role in the difference between the State board (3.09±0.04) and Central board efficacy levels (3.23±0.03). Physics and Chemistry showed a clear statistical significance between different boards whereas Mathematics observes no statistical significance. In subjects, physics and chemistry with respect to gender observed a significant difference between State and Central Board students whereas for Mathematics the gender difference was non-significant.

Keywords: Engineering Education, Educational Boards, Central Board of Secondary Education (CBSE), State Boards, Self-Efficacy, Academic Performance.

INTRODUCTION

Engineering education is the most sought one by the students as well as by their parents. The geometrical growth in IT Industry has helped many engineers with lucrative jobs. This in turn has raised the economical status of middle income groups to the new orbit of lifestyle. In the year 2010-11 India produced 1,324,246 engineers. (Source: www.aicte-india.org.). This number is still increasing, but the quality is the question. Alvarez (2000) [1] highlights the two important functions of education of which one represents the individual and the other is social. At the individual level, the youth is preparing him for a career and also developing the cognitive functions. At social level, the advancement is for human and social capital which helps in nation building. In India there is a need for balanced development in education. The evolution of schooling is from knowledge generation to delivering skills. This will help the student to transform knowledge, and communicate effectively in relation to Language, Culture and Technology [2, 3]. Defining the 'Quality' of a school is a very difficult and complex problem [4], and the quality of education differs from culture to culture. According to parents and student the quality represents the examination marks or grades.

HIGHER SECONDARY EDUCATION

Higher Secondary education in India is travelling through a new phase. India is following a 'Service led Growth' model and is working hard to survive in the global competition. The Higher secondary education is getting its pressure from both 'Bottom-up' and 'Top-down' directions. The Bottom-up pressure is because of the high growth in the primary schooling and Top-down pressure is because of its commitment to produce quality students for higher education. Further, on the Indian system of higher education which is known as 'Macaulay System' prepares students for the white collar jobs. Mid twentieth century, started with a new beginning for secondary education in India [5]. Developing countries found themselves fixed, as there was set pattern on academic secondary education. The World Bank Report

(2005) [6] stated that, it was very important to invest in secondary education, which helps in increasing social and economic returns nation building. The World Bank (2009) [7]report on secondary education in India expressed that the elementary education had grown rapidly in the last twenty years, for which major contribution was from private unaided schools. The secondary education is growing slowly but steadily. The projections given by World Bank (Jan 2009) estimated that the absolute demand for higher education would increase from 17 million students per year to 40 to 57 million students in a decade.

DIFFERENT EDUCATIONAL BOARDS

The learning orientations are differentiated as meaningful learning and rote learning. The significance is that the characteristic properties of different schools have an impact on the students' learning which has associated factors like curriculum content, assessment procedures, learning materials and teaching aids [8]. The result of the study [9] confirms that there is a significant difference between different types of schools and different learning orientations. Also learning differs, based on the place of school (Rural or Urban) and type of school (Day or Boarding).Walberg (1981) [10] in his 'Theory of Educational Productivity' identified 9 productivity factors namely affective, cognitive and behavioural skills. The ultimate goal of different boards of education is to maximise the quality of education. The Indian education system comprises boards like Central Board of Secondary Education (CBSE), State Educational Boards and Council Examination (CISCE) which is conducted for the ICSE and ISC schools. This study report is on the CBSE and State Boards Schools, their impact on academic achievements of higher secondary grade students and their learning the subjects such as Mathematics, Physics and Chemistry.

Central Board of Secondary Education (CBSE)

The Central Board of Secondary Education, popularly known as CBSE is the official governing body of education system in India. In 1921, it was started as UP (Uttar Pradesh) Board of High School and Intermediate Education. In 1952 the Constitution of Board was amended and the jurisdiction was extended and named as Central Board of Secondary Education. The main objective of the board is to serve the educational institutions effectively, and also to the educational needs of the students [11].

The prime focus is on

Innovative Teaching Methodologies

Reforms in Examination and Evaluation Practices

Skill Learning for Job-oriented and Job-linked Inputs.

The CBSE recommends syllabus of NCERT (National Council of Educational Research and Training) for the students of Lower Kinder Garden (LKG) to class VIII. CBSE prepares the curriculum for the IX to XII and it conducts exams for students of Tenth(X) and students of Twelveth (XII) usually known as +2. Learning curve in CBSE board education is based on practical orientation which makes the students to have more hands on experience. The evaluation result is declared in terms of grades.

State Educational Boards

India is a diversified country in terms of culture, language etc., in education also every state practice its own way of educational system. Every state government has Department of Education and have their affiliated schools under them. Tamil Nadu is known its quality education. The state government has fallen in line with the national level pattern with 12 years of schooling. Tamil Nadu has 5660 Secondary schools under its affiliation.

To quote on different boards of education [12] "The difference between State Board and CBSE School is endemic to our education system and common across India". The problem is due to curriculum and also the education system of different state boards. But CBSE schools are better equipped to overcome the problem.

SELF-EFFICACY AND ACADEMIC ACHIEVEMENTS

Self-efficacy [13] is defined as "people's judgement of their capabilities to organise and execute courses of action required for attaining designed types of performances". Many studies are conducted to prove the effects of self-efficacy on students' academic achievements. Self-efficacy is the internal capacity of a student on his learning and academic achievement [14]. It is proved beyond doubt that the self-efficacy assessment is related to the performance in subjects like Mathematics, Physics and Chemistry.

Mathematics

For the secondary school students it is observed that mathematics in an important subject which is interconnected to his academic and career prospects [15]. The European Report on the Quality of School Education [16] firmly asserts that mathematics is the core foundation of the educational curriculum. The report further establishes a stronger relationship between mathematics and higher achievement.Pajares&Schunk [17] attributed the students' success in reading, writing, arithmetic and thinking are related to their Self-efficacy. Williams [18] studied the high school Students and found that students with higher level of self-efficacy scored higher in Subjects especially in mathematics. Stage & Kloosterman [19] also observed in the same way that successful performance and self-efficacy go hand in hand not only in mathematics but also in other subjects. What is observed by Efficacy (2005) reported by Tuntufye S. Mwamwenda [20] is more interesting. The physical growth in children and their learning mathematics are associated to one another, that is they become capable or incapable of solving problems. Further the findings state that self-efficacy is attributed to the factors like personal, environmental and behavioural.

Physics

Sajid Jamal and Sheeba Hasan [21] have observed that mathematics and physics have historical link to their developments and are interwoven and closely netted. Trumper [22] has clearly mentioned the importance of physics to the higher secondary students as it is a kind of "Gate-Keeper" for science, technology and medical Studies. But the difficulty of learning physics [23] lies in learning the formulas, calculations, graphs

and concepts. Physics learning can be made easy by the teacher, course content, availability of apparatus for laboratory experiments, a clear and workable plan for meeting the needs of the students, financial support to meet the requirements and dedication of the student [21]. The student's interest in physics is also related to the negative opinion about the physics classes [22]. Physics along with several topics on the history of science could increase the students' interest [24].

Chemistry

Mathematics, Physics and Chemistry are the three important subjects of basic science for the higher studies either in Engineering or in Medicine. The difficulties in learning Chemistry [25,26] are to its "abstracts unobservable particulate basis" and the need to "agile transfer across the various levels of chemistry understanding". Being chemistry [27], one of the difficult subjects on evolving makes the learners repulse it and discontinue it eventually. The reason is that the change in subject offers a solution. To make chemistry learning simple by incorporating IT enabled Project Based Learning (PBL).

METHODOLOGY

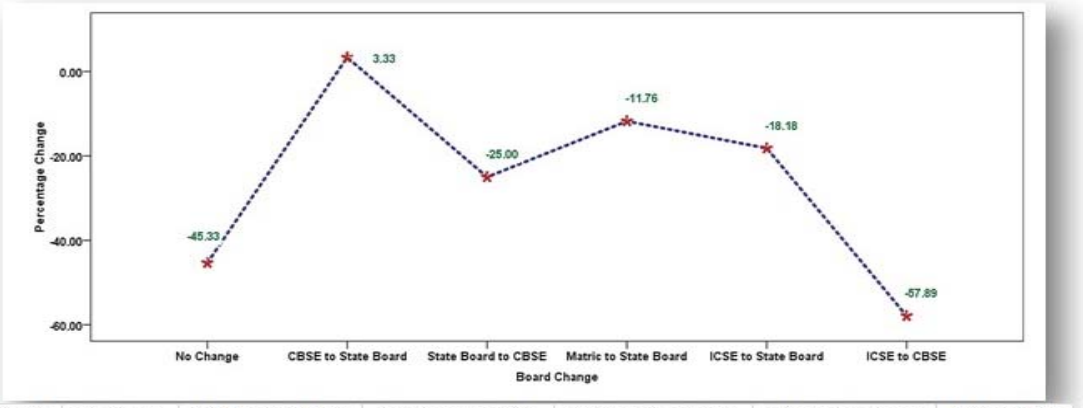
The research was done with 370 students of first year engineering who joined recently in their first semester in a private deemed university. The male students are 292 (78.92%) and female students are 78 (21.08%). Their minimum age is 16 and maximum age is 20. The mean age is 17.80 (SD-0.660). In this study, General Self-Efficacy Scale (GSE) developed by Mathias Jerusalem and Ralf Schewarzer [28] is used to assess the self-efficacy of students. The responses are measured for 10 items with a 4 point scale from 'not at all true' to 'exactly true'. For Assessing the student's confidence level on the subject's namely mathematics, physics and chemistry, the 'Pittsburgh Freshman Engineering Students Attitude Assessment Survey' was used. The data for this study were double verified, entered and analysed using the SPSS Version 14.0 (Statistical Package for the social sciences, INC, Chicago, IL, USA). The variables were explored using the analysis such as Mean, Standard Deviation, Analysis of Variance, Pearson's Correlation analysis and the Structural Equation Model at 5% level of significance.

RESULTS AND DISCUSSION

The finding of this research indicated that change in board influenced academic performance in higher secondary school education, and there was no statistical significance ($p=0.064$) Examination in the output. The students moved from state board to CBSE (-25.00±62.9), from metric to state board (-11.8±14.6), from ICSE to state board (-18.2±76.1) and ICSE to CBSE (-57.0±13.9). There was downward trend when they moved out. But students who moved from CBSE to State board (3.3 ± 17.6) had an upward trend and could enhance their academic performance in terms of percentage scored in the final examination, which is supposed to be the deciding factor for entry in to higher education.

The study also showed with respect to gender, the singularity of the Male students had a significant role in the difference between the State board (3.09±0.04) and Central board (3.23±0.03).

The results conveyed that, there exists a difference in the self-efficacy levels of state board students (3.11±0.04) and CBSE students (3.23±0.03).



Board	No Change	CBSE to State Board	State Board to CBSE	Matric to State Board	ICSE to State Board	ICSE to CBSE
μ ± CI	-45.3 ± 4.9	3.3 ± 17.6	-25 ± 62.9	-11.8 ± 14.6	-18.2 ± 76.1	-57.9 ± 13.9
F - Ratio	2.109					
Sig.	0.064					

Fig 1: Change of Board influencing the academic performance in Higher Secondary

Table 1: Self Efficacy of the different boards

Group	Board	μ ± CI	F-Ratio	Sig.
All	State Board(n=148)	3.11 ± 0.04*	3.980	0.019
	CBSE(n=204)	3.23 ± 0.03*		
	Others (n=18)	3.07 ± 0.09		
Male	State Board (n=131)	3.09 ± 0.04*	4.240	0.015
	CBSE (n=148)	3.23 ± 0.03*		
	Others (n=13)	3.16 ± 0.08		
Female	State Board (n=17)	3.16 ± 0.10	0.937	0.396
	CBSE (n=56)	3.23 ± 0.10		
	Others (n=5)	2.82 ± 0.22		

(Note: Analysis of Variance and Bonferroni Multiple Comparison was made at 5% level of Significance)

The analysis of the confidence level of the students on subjects like mathematics, Physics and chemistry was done with Kruskal Wallis Statistics.

Table 2: Influence of the board in the subject skill Mathematics

Board	Strongly Agree		Agree		Neither agree nor disagree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
State Board (n=148)	78	52.7	41	27.7	16	10.8	9	6.1	4	2.7
CBSE (n=204)	95	46.6	61	29.9	28	13.7	15	7.4	5	2.5
Others (n=18)	9	50.0	6	33.3	2	11.1	1	5.6	0	.0
Total	182	49.2	108	29.2	46	12.4	25	6.8	9	2.4
Kruskal Wallis Statistics	1.403									
Sig.	0.496									

The result conveyed that there was not much of statistical significance between the students of different boards with respect to mathematics. Then the influence was tested with respect to gender which also showed that the significance was negligible.

Table 3: Influence of the board in the subject skill Physics

Board	Strongly Agree		Agree		Neither agree nor disagree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
State Board (n=148)	26	17.6	66	44.6	41	27.7	13	8.8	2	1.4
CBSE (n=204)	52	25.5	94	46.1	41	20.1	14	6.9	3	1.5
Others (n=18)	5	27.8	12	66.7	1	5.6	0	.0	0	.0
Total	83	22.4	172	46.5	83	22.4	27	7.3	5	1.4
Kruskal Wallis Statistics	8.260									
Sig.	0.016									

For the subjects like Physics (8.260 sig 0.016) and chemistry (12.231 sig 0.002) the results showed a significant difference between the state board and CBSE. In both the subjects with respect to gender male students showed a significant difference between state and central board efficacy levels.

Table 4 : Influence of the board in the subject skill Chemistry

Board	Strongly Agree		Agree		Neither agree nor disagree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
State Board (n=148)	23	15.5	56	37.8	49	33.1	18	12.2	2	1.4
CBSE (n=204)	49	24.0	93	45.6	50	24.5	8	3.9	4	2.0
Others (n=18)	1	5.6	10	55.6	3	16.7	3	16.7	1	5.6
Total	73	19.7	159	43.0	102	27.6	29	7.8	7	1.9
Kruskal Wallis Statistics	12.231									
Sig.	0.002									

In this study, change in board of studies in higher education (from 10th standard to 11th standard), has showed no statistical significance but a definite change was observed when the student moved from one board to the other. An upward trend was seen when student moved from CBSE to State Board (3.3±17.6) and downward trend was noticed in all other changeovers. The reason for change from one board to another is not studied separately, but the reason may be attributed to the marks scored in the final board examination. The mark scored was directly proportional to admission in the university ranked engineering colleges in Tamil Nadu, where the admission is conducted by a method called 'Single Window Counselling'. This conclusion was not the generalised one for the students of India, who prefers to write the 'All India Competitive Exams' for various professional courses. The results also suggested that a scope for further study on the learning methods like meaningful learning and rote learning. The CBSE advocates the meaningful learning with lots of activity based project learning for the students, whereas the state board syllabus promotes rote learning. The academic self-efficacy is a domain oriented concept and it has its relationship to various measures which are regularly studied to find out the task specific interest of students (ex: subtraction) Bandura &Schunk [29]. This study analyzed the general self-efficacy of students of both central and state board, and their confidence level on the subjects namely mathematics, physics and chemistry. The study highlighted the marked difference in the self-efficacy levels of boys than of girls. When compared CBSE boys outsmarted the state board boys but the same was not observed with the girls. The reason for this could be attributed to the general tendency of girls towards their education. The study report [30] highlighted that girls usually work harder towards better grades at schools than boys. Farooq et al [31] opinions that gender strongly affected the performance with girls performing better in the subjects like Mathematics and English as well as cumulatively. Muhammad Yusuf [32] from his research study observed a direct effect of self-efficacy on the CGPA. Academic self-efficacy is the direct predictor and mediator for academic achievement [33].

This study analyzed confidence level of CBSE and State Board students towards the subjects like Mathematics, Physics and Chemistry. Physics and Chemistry

showed a clear statistical significance between different boards whereas Mathematics observes no statistical significance. For physics and chemistry with respect to gender there was significant difference between State and Central Board students whereas for Mathematics the gender difference was non-significant.

CONCLUSION

Bandura [13] identifies "Student who wants to develop strong of self-efficacy are well equipped to educate themselves when they have to rely on their own initiatives" (P417). This study was done on the 'Aspiring engineering students and their abilities in basic science subjects'. The study has not got into the details of Curriculum, Pedagogy, Examination Patterns and Evaluation Procedures. For further research the above factors can be taken in to consideration. Creating and accumulating arrears is another problem which has a direct effect on completion of graduation and as well as meeting the eligibility criteria in campus recruitment process. Specifically Engineering mathematics is one paper the students find it difficult to clear. Continuous research on self-efficacy in the academic domain has strengthened Bandura's [13] assertions that "Self efficacy beliefs play an influential role in human agency".

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